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ABSTRACT

This report presents the results of a fall 1997 survey of U.S. colleges and universities that offer doctoral, master's, and bachelor's degrees in physics and astronomy, focusing on degree production and current student enrollment. Highlighted are the following: (1) although enrollments in physics degree programs have been declining, the number of students taking introductory courses has remained fairly stable; (2) the number of Ph.D.s conferred during the 1996-97 academic year declined 2 percent from the previous year, with a cumulative drop of 6 percent over the last three years; (3) bachelor's degrees in physics continue to decline, with the class of 1996-97 totaling 3,826 degrees (the lowest since the late 1950s); (4) the number of U.S. citizens enrolling as first-year graduate physics students is the lowest ever seen; and (5) the proportion of women physics bachelor's recipients has increased, on average, about 1 percent a year for the last four years, although women still represent only 19 percent of the undergraduate physics class of 1997. Text, figures, and tables present data on introductory enrollments; undergraduate enrollments and degrees; graduate enrollments and degrees; gender, race, and citizenship; and astronomy. An appendix provides trend data on degrees and enrollments over the last 10 years. (DB)

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AIP Pub No. R-151.35

March 1999

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ENROLLMENTS AND DEGREES REPORT

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ENROLLMENTS AND DEGREES REPORT

HIGHLIGHTS

- Although enrollments in physics degree programs have been declining at both the undergraduate and graduate levels, the number of students taking introductory physics courses has remained fairly stable. During the 1996-97 academic year, approximately 368,000 students took an introductory physics course at one of the 761 degree-granting physics departments. (**Figure 1**)

- The number of PhDs conferred during the 1996-97 academic year (1385) declined 2% from the previous year, with a cumulative drop of 6% from the recent high of three years ago. Given present enrollment figures, the future certainly holds far greater declines for physics doctoral production in the US. (**Figure 7**)

- Physics bachelor's degrees continue to decline, with the class of 1996-97 totaling 3,826 degrees. The size of an undergraduate physics class has not been at this level since the late 1950s. (**Figure 2**)

- The number of US citizens enrolling as first-year graduate physics students is the lowest ever seen in the 30+ years of this report series. (**Figure 5**)

- The proportion of women among physics bachelor's recipients has increased on the average of one percent a year for the last four years. Even so, women still represented only 19% of the undergraduate physics class of 1997. (**Figure 8**)

Physics degree production at colleges and universities across the US continues to decline at all levels. Bachelor's degree production is at a four decade low. Master's degrees, especially those conferred to individuals enroute to a PhD, have fallen sharply. PhD production, which has declined 6% during the past three years, is only just beginning what will be a steady and sustained decline.

These declines are motivating many physics departments to develop recruiting techniques to attract new students, whereas in years past many of these same departments had an ample applicant pool from which to choose. As declining enrollments have lowered student to faculty ratios, many departments have faced threats of cutbacks. Some departments are also turning to developing interdisciplinary curricula

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in an attempt to bolster their program enrollments. As of yet, few departments have had to discontinue their physics degree-granting status as a result of the enrollment declines.

The Education and Employment Statistics Division of AIP conducts the Survey of Enrollments and Degrees each fall, contacting all degree-granting physics and astronomy departments in the US. Data on the number of degrees conferred by a department in the previous academic year as well as the current year's undergraduate and graduate enrollments make up the core of the survey. The aggregate data are used to extend long-standing trends that depict the changing dimensions of the physics and astronomy community.

This year we received responses from 100% of the 761 degree-granting physics departments and 94% of the 69 astronomy departments (see **Table 1**). Since the data on enrollments and degrees are so fundamentally important, a great deal of time and effort is spent obtaining responses from as many departments as possible. It is through the regular cooperation of departmental chairpersons, faculty and staff that we are able to tabulate these figures and trends for the nation as a whole.

Table 1. Departments by highest physics degree offered, 1997-98.

	Number of Depts.	Percent of Depts.
PhD-granting	182	24
Master's-granting	74	10
Bachelor's-granting	505	66
Total	761	100%

Source: AIP Enrollments and Degrees Report, R-151.35

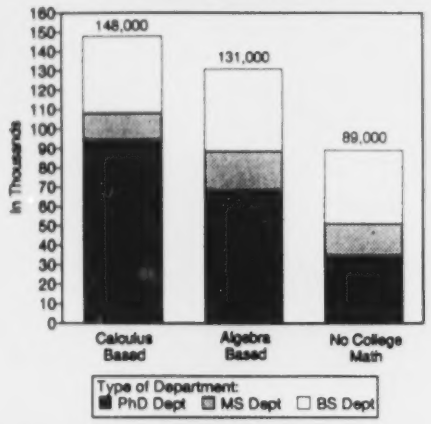
The appendix tables of this report list recent trends in annual degree production and enrollments for physics and astronomy departments. The actual school-by-school figures that form the basis for the aggregates reported here are available in two separate publications, the ***Roster of Physics Departments with Enrollment and Degree Data*** and the ***Roster of Astronomy Departments with Enrollment and Degree Data***. These reports are available at no cost from this division or from our web site, www.aip.org/statistics.

INTRODUCTORY ENROLLMENTS

While physics departments have been experiencing substantial declines in degree program enrollments, introductory physics course enrollments have remained strong. During the 1996-97 academic year approximately 368,000 students received their first exposure to a physics course at one of the degree-granting physics departments. The continuing strong demand for introductory physics instruction illustrates the important role physics departments play in providing service courses to a wide range of non-physics majors.

Only about one percent of the students who take an introductory course are destined to become physics bachelor's degree recipients three or four years later. The content of the introductory courses, especially the amount of math background required, may vary greatly in an attempt to present the courses at levels appropriate for the variety of non-physics majors enrolled. **Figure 1** shows the distribution of students taking introductory physics by the math prerequisite required for the course.

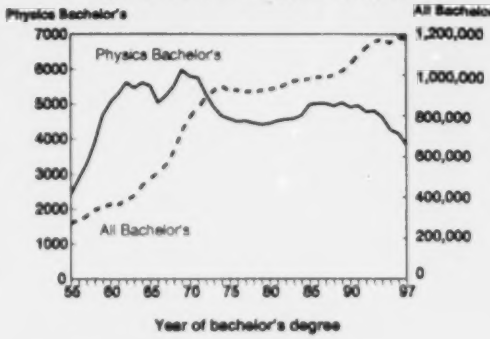
Figure 1. Introductory physics enrollments by math level of course and type of department, academic year 1996-97.



Note: Includes only degree-granting departments with physics programs.

Source: AIP Enrollments and Degrees Report, R-151.35

Figure 2. Physics bachelor's and total bachelor's produced in the US, 1955 to 1997.



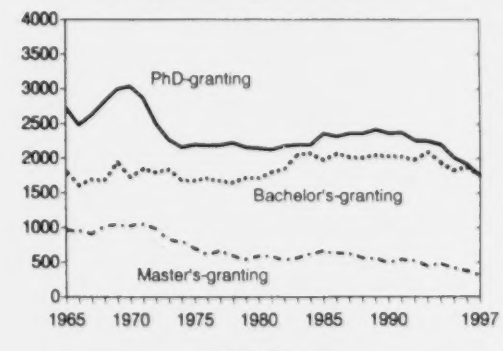
Source: AIP Enrollments and Degrees Report, R-151.35 and NCES Digest of Education Statistics

UNDERGRADUATE ENROLLMENTS AND DEGREES

At a time when the overall US bachelor's degree production has been increasing steadily, the total number of physics bachelor's degrees conferred continues to decline. The 3,826 degrees conferred on the class of 1996-97 represents a drop of 8% from the previous year and 24% from the recent high in 1989 (see **Figure 2**). Undergraduate physics degree production has not been this low since the late 1950's. During this same time period, overall bachelor's degree production has increased four fold.

Though physics bachelor's production has been declining at all department types, programs that also offer a graduate program in physics have experienced the greatest losses (See **Figure 3**). Departments with the masters as their highest degree have lost the largest proportion of their undergraduate majors, a decline of 52% since 1989. This is followed by the doctoral-granting departments, whose undergraduate degree production has declined by 28%. The bachelor-only departments have experienced the least decline, falling by only 11%. Though the decline at the undergraduate-only departments is smallest in percentage terms, the impact at these departments may be very high. With many of these departments having small class sizes to begin with, a drop of one or two students has the potential to reduce a department's size by half.

Figure 3. Physics bachelor's degrees awarded by department type, 1965-1997.



Source: AIP Enrollments and Degrees Report, R-151.35

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Declines in undergraduate degree production are expected to continue for at least the next year or two; however there is a possibility that enrollments may be leveling off. Undergraduate physics enrollments at the junior level fell by only 1% from the previous year, following three years with declines of 5% or greater.

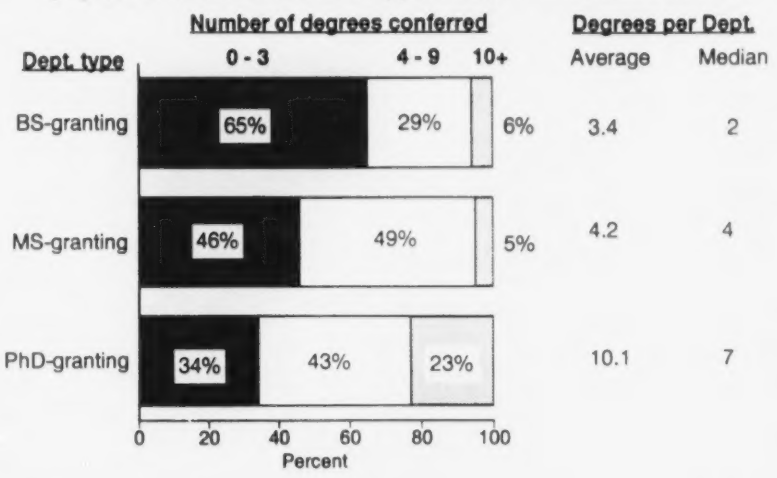
Figure 4 reinforces the fact that physics departments that grant the bachelor's as their highest degree are relatively small, with two-thirds of them conferring three or fewer bachelor's degrees during the 1996-97 academic year. The median number of degrees conferred by these departments was two. In contrast, the doctoral-granting departments are larger and had a median undergraduate degree production more than three times as large. Although most bachelor-only departments are relatively small, they are responsible for conferring almost half of this country's undergraduate physics degrees.

GRADUATE ENROLLMENTS

After a five-year, 27% decline in first-year graduate student enrollments, the overall number of incoming graduate physics students leveled off in the academic year 1997-98 (See **Figure 5**). Total graduate student enrollments continued to decline in 1997-98, falling 4% from the previous year and 22% since the recent high in 1992.

Although incoming enrollments as a whole are basically unchanged from the previous year, particular segments of the first-year student body are still experiencing serious declines. The number of US citizens continues to fall, about 4% in 1997-98 from the previous year, with a cumulative decline of 37% since 1992. First-year US graduate physics enrollments are the lowest they have been in the more than three-decade history of this report series. Foreign student

Figure 4. Distribution of physics departments by size of physics bachelor's class and type of department, class of 1997.



Source: AIP Enrollments and Degrees Report, R-151.35

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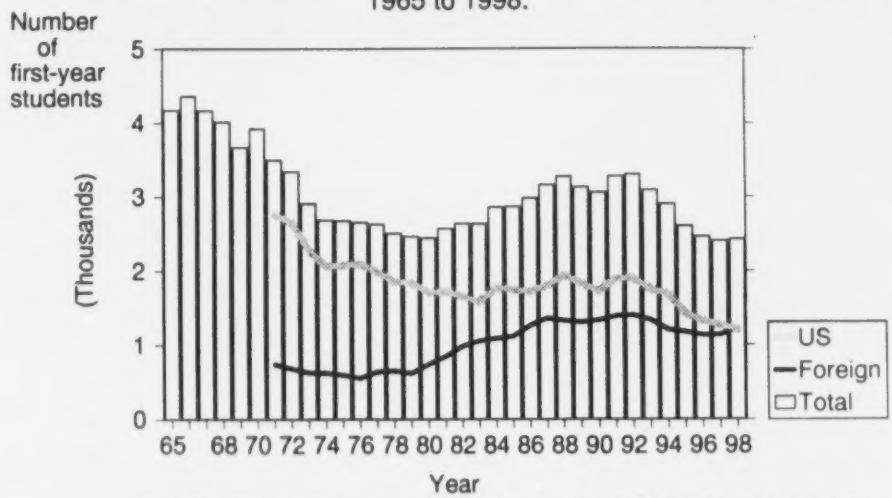
Figure 5. First-year US and foreign graduate physics students, 1965 to 1998.



Note: Refinement in wording may slightly raise the 1995 foreign citizen totals relative to that reported in earlier years. A citizenship breakdown of first-year student enrollments is not available prior to the academic year 1970-71.

Source: AIP Enrollments and Degrees Report, R-151.35

enrollments actually increased for 1997-98, by about 6% from the previous year, and are only off 13% from their peak in 1992. As a result, the incoming physics graduate enrollments include for the first time ever, an equal number of US and foreign students.

Another area where declines in first-year student enrollments are continuing to fall is at departments where the master's is the highest physics degree offered. The size of the incoming class at master's departments declined 10% from the previous year, with a cumulative decline of 38% since 1992. These departments were responsible for enrolling 12% of the incoming physics students for the 1997-98 academic year.

As a result of these declines, many departments report that they are facing a lack of qualified students applying to their departments, especially US students. Almost three-quarters of the PhD-granting departments and about 8 out of 9 of the master's-granting departments would have accepted a larger number of incoming students in the fall of 1997 if additional qualified candidates had applied. Master's-only departments are experiencing greater difficulties due to the fact that they generally have less funding to offer students than PhD programs do. Of the PhD programs with a desire to accept additional qualified students, a little more than half of them would have accepted any additional qualified applicant, while the remaining departments would have only taken additional applicants if they were US citizens.

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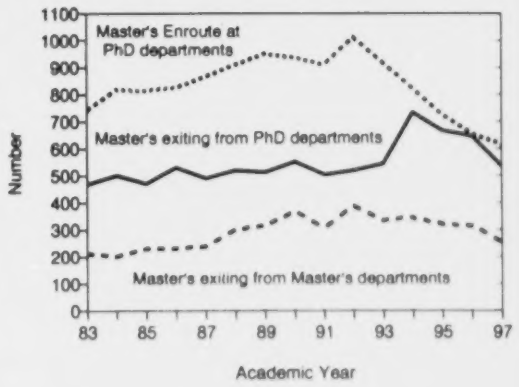
GRADUATE DEGREES

For the 1996-97 academic year there were 257 graduate physics departments, 182 of which offer the doctorate as their highest degree and 75 at which the master's is the highest degree available. Together, these departments produced 1,385 PhDs and 1,406 masters.

Master's degrees fall into two main categories: (1) students leaving a physics department with the master's as their highest degree (2) students earning a Master's Enroute degree, an interim degree earned at a doctoral-granting department by a student in pursuit of a physics PhD.

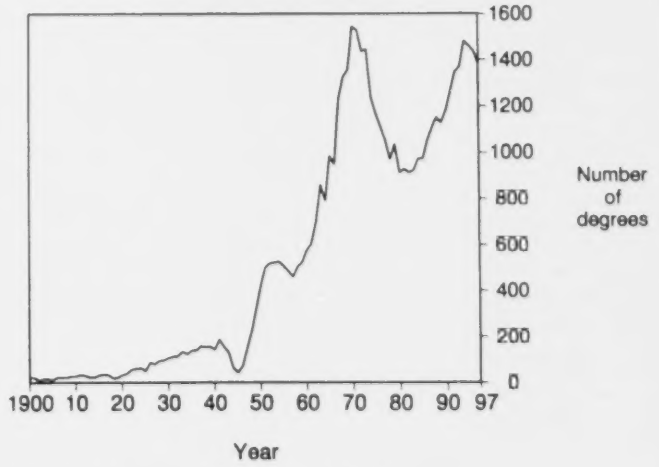
Departments reported conferring 617 Master's Enroute degrees on the class of 1997. This figure is down 6% from the previous year and 39% from five years ago (see **Figure 6**). Although not all

Figure 6. Master's degrees conferred by type of degree and department, 1983-1997.



Source: AIP Enrollments and Degrees, R-151.35

Figure 7. Number of physics PhDs conferred in the United States, 1900 to 1997.



Sources: ACE (1900-19), NAS (1920-61), AIP (1962-97) Statistics Division, The American Institute of Physics.

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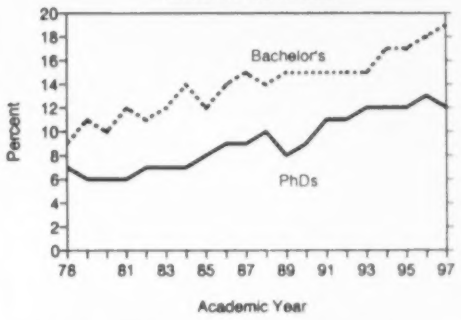
doctoral candidates receive this interim degree, this trend follows the decline seen in first-year student enrollments and reinforces the certainty of the impending declines at the PhD level. The number of students receiving a master's degree as their final physics degree at the department in which they were attending is also falling. Declines of 17% and 19% from the previous year were experienced at the doctoral- and masters-granting departments respectively.

The number of PhDs conferred on the class of 1997 was 1,385 (see **Figure 7**). This marks the third consecutive year that PhD production has fallen. Though this decline is only 2% from the previous year and 6% for the last three years, as noted earlier, greater declines in the future are an inevitable result of the large drop in first-year student enrollments during the past six years.

Figure 8. Percent of bachelor's degrees and doctorates in physics granted to women, class of 1978-1997.



Note: A from change occured in 1994 resulting in a more accurate representation of women among physics bachelors. Some of the increase in 1994 may be a result of that change.

Source: AIP Enrollments and Degrees Report, R-151.35

Table 2 presents the proportion of women and foreign citizens among physics degree recipients in the class of 1997. The proportion of foreign citizens has remained relatively stable for all

GENDER, RACE and CITIZENSHIP

The proportion of women earning a bachelor's degree in physics has risen about 1% a year for the last four years, bringing the representation of women among physics bachelors up to 19% for the class of 1997 (see **Figure 8**). Although the representation of women among the PhD recipients in the class of 1997 fell by a percent from the previous year, the overall percentage of women at both the bachelor's and doctorate levels has more than doubled during the past two decades.

Table 2. Percent of women and foreign citizens among recent physics degree recipients, class of 1997.

Degree	Women %	Foreign* %
Bachelor's	19	7
Professional / Terminal Master's	18	36
PhDs	12	45

*Foreign citizens include individuals with permanent resident status as well as those with temporary visas.

Source: AIP Enrollments and Degrees Report, R-151.35

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Table 3. Number and percent of physics degrees granted to US citizens by minority / ethnic group status, class of 1997.						
	Bachelor's		Terminal / Professional Master's		Doctorates	
	Number	Percent	Number	Percent	Number	Percent
White	3078	87	438	87	671	88
African-American	181	5	17	3	11	2
Asian-American	158	4	21	4	43	6
Hispanic	83	2	18	4	16	2
Other	58	2	8	2	24	2
Total US Citizens	3558	100%	502	100%	765	100%

Source: AIP Enrollments and Degrees Report, R-151.35

three degree types in recent years, but is likely to rise among future PhD classes as a result of the increasing proportion of incoming students with foreign citizenship.

The representation of African and Hispanic-Americans among physics degree recipients remains low. At the same time, Asian-Americans continue to be overrepresented (see **Table 3**). Bachelor's and master's degrees granted to African-Americans are concentrated in a limited number of departments. Similarly to years past, 60% of the bachelors degrees and 38% of the masters awarded to African-Americans in the class of 1997 were conferred at one of the nations 34 historically black colleges and universities (HBCU) that have a degree program in physics. **Table 4** lists the institutions that conferred the largest number of physics bachelor's degrees to African-Americans in recent years; all of them are HBCUs.

Table 4. Institutions averaging the largest number (4 or more) of African-American physics bachelors, 1995-97	
	3 year average
Xavier U (LA)	14
Lincoln U (PA)	8
Southern U and A&M Coll (LA)	7
Tuskegee U (LA)	6
North Carolina A&T St U (NC)	5
Grambling St U (LA)	5
Jackson St U (MS)	5
Hampton U (VA)	5
Clark-Atlanta U (GA)	4
Stillman Coll (AL)	4
Delaware St U (DE)	4
Morgan St U (MD)	4
Norfolk St U (VA)	4

Source: AIP Enrollments and Degrees Report, R-151.35

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ASTRONOMY

The 69 departments with an astronomy degree program fall into two distinct groups. About half are stand-alone departments devoted strictly to the field of astronomy, while the remaining half are administered in conjunction with a physics degree program (see **Table 5**). This year we received responses from all but 4 of the departments that offer an astronomy degree. The data presented here include estimated figures for the non-responding departments. These estimates were derived from responses received in previous years.

Table 5. Number of degree-granting astronomy departments by highest astronomy degree offered, academic year, 1997-98.

Department Type	Combined with Physics	Separate Astronomy	Total
PhD-granting	10	29	39
Master's-granting	2	2	4
Bachelor's-granting	21	5	26
Total	33	36	69

Source: AIP Enrollments and Degrees Report, R-151.35

It should be noted that students also receive degrees in astrophysics from strictly physics departments as well as from departments granting astronomy degrees. Astrophysics degrees conferred by these physics-only departments are included in the section on physics degrees above.

Approximately 167,800 students took an introductory astronomy course during the 1996-97 academic year (see **Table 6**). This enrollment figure is about 10% higher than the previous year. Consistent with past years, about twice as many students took their introductory astronomy course at one of the many departments where there is no astronomy degree program.

Table 6. Introductory astronomy course enrollments by department type, academic year 1996-97.

	Bachelor's-granting	Master's-granting	Doctoral-granting	Total
Astronomy & combined departments	8,300	2,500	43,500	54,300
Physics department	44,500	24,500	44,500	113,500
Total	52,800	27,000	88,000	167,800

Note: Table only includes enrollments at degree-granting physics and astronomy departments.

Source: AIP Enrollments and Degree Report, R-151.35

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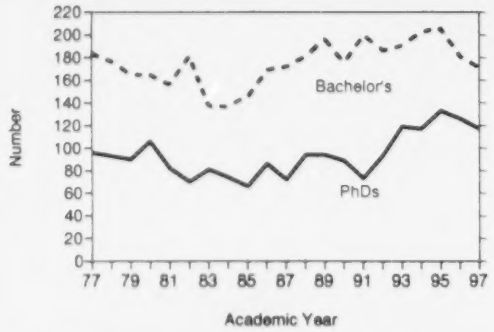
Introductory astronomy enrollments comprise almost a third of the introductory enrollments for physics and astronomy combined. This proportion is even more impressive when one considers all the students who need to take an introductory physics class to fulfill a requirement for their major. Much of astronomy's enrollment draw comes from students choosing it as the subject to meet their university's science requirement.

The astronomy class of 1996-97 consisted of 177 bachelor's degrees, 23 terminal master's degrees and 117 doctorates (see **Figure 9**). First-year graduate astronomy enrollments have dropped by one-third since the entering class of 1991. All three of these degree types experienced a decline from the previous year's totals. Doctorate production is dropping from an all time high in 1995, which resulted from high first-year student enrollments in the early 1990's.

Figure 9. Astronomy bachelor's degrees and doctorates awarded in the US, 1977-1997.



Note: The astronomy doctorate totals presented here do not include astrophysics degrees conferred by physics departments. Those degrees are included among the physics totals.

Source: AIP Enrollments and Degrees Report, R-151-35

Table 7 presents the makeup of astronomy degree recipients by gender and citizenship for the class 1997. As has been true in the past, women have a higher representation and foreign citizens a lower representation in astronomy than among individuals receiving physics degrees. **Appendix A1** presents ten years of astronomy data at both the undergraduate and graduate levels.

Table 7. Percent of women and foreign citizens among recent astronomy degree recipients, class of 1997.

Degree	Women %	Foreign* %
Bachelor's	33	9
Professional / Terminal Master's	30	17
PhDs	19	27

* Foreign citizens include individuals with permanent resident status as well as those with temporary visas.

Source: AIP Enrollments and Degree Report, R-151.35

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APPENDIX

Table A1. Trend in astronomy enrollments* and degrees, academic years 1987 to 1998.

	Number of astronomy degrees granted				Undergraduate astronomy major enrollments		Graduate astronomy student enrollments	
Academic year	Bachelors	Masters Enroute	Terminal Masters	PhDs	Juniors	Seniors	1st year	Total
1987-88	181	49	26	94	250	285	171	731
1988-89	196	71	22	94	213	275	169	780
1989-90	176	75	19	89	223	236	186	842
1990-91	200	65	25	73	312	284	226	914
1991-92	186	80	31	93	290	331	175	935
1992-93	190	46	56**	119	337	348	173	939
1993-94	203	73	34	117	257	388	180	901
1994-95	205	72	43	133	269	351	165	905
1995-96	181	55	44	126	272	361	149	874
1996-97	177	67	23	117	265	332	155	837
1997-98					252	330	143	777

* Includes part-time students.
** Thirty-four Masters came from the Arizona Summer Science Institute for science teachers at the University of Arizona.

Table A2. Trend in physics enrollments* and degrees, academic years 1987 to 1998.

	Number of physics degrees granted			Undergraduate physics major enrollments		Graduate physics student enrollments	
Academic year	Bachelors	Total Masters**	PhDs	Juniors	Seniors	1st year	Total
1987-88	4937	1733	1150	6412	7017	3274	13143
1988-89	5033	1781	1112	6390	7116	3132	13361
1989-90	4898	1857	1183	6313	7131	3059	13708
1990-91	4950	1718	1264	6445	7115	3278	14065
1991-92	4770	1918	1346	6435	7268	3306	14534
1992-93	4800	1797	1369	6287	7297	3090	14430
1993-94	4615	1899	1481	6146	7289	2902	14201
1994-95	4263	1710	1461	5620	6836	2604	13285
1995-96	4156	1614	1438	5335	6489	2462	12596
1996-97	3826	1406	1385	5057	6116	2404	11786
1997-98				5006	5857	2423	11302

* Includes part-time students
** Includes both Terminal / Professional Masters and Masters Enroute.

Table A3. Trend in physics enrollments* and degrees by institution type, academic year 1991 to 1998.

Academic year	Number of physics degrees granted			Undergraduate physics major enrollments		Graduate physics student enrollments	
	Bachelors	Total Masters**	PhDs	Juniors	Seniors	1st year	Totals
Doctorate-granting institutions							
1991-92	2261	1530	1346	3057	3729	2831	13118
1992-93	2253	1463	1369	3038	3845	2688	13222
1993-94	2203	1554	1481	2920	3729	2509	13042
1994-95	2009	1390	1461	2648	3453	2209	12173
1995-96	1918	1299	1438	2461	3344	2117	11545
1996-97	1746	1152	1365	2200	3133	2074	10900
1997-98				2223	2899	2127	10432
Master's-granting institutions							
1991-92	525	388		802	938	475	1416
1992-93	448	334		719	887	405	1208
1993-94	475	345		696	930	393	1159
1994-95	420	320		610	813	395	1113
1995-96	376	315		556	703	345	1047
1996-97	314	254		530	667	330	886
1997-98				561	636	296	870
Bachelor's-granting institution							
1991-92	1984			2576	2601		
1992-93	2099			2530	2565		
1993-94	1937			2530	2630		
1994-95	1834			2362	2570		
1995-96	1862			2318	2442		
1996-97	1766			2327	2316		
1997-98				2225	2322		

* Includes part-time students

** Includes both Professional / Terminal Masters and Masters Enroute